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BIOLOGICAL EVALUATION
Western Spruce Budworm

National Forest, National Park,
Indian Reservation, State, and Private Lands
Region 3

1976

Forest Insect and Disease Management
State and Private Forestry
Southwestern Region, Forest Service, USDA
517 Gold Avenue, SW
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TECHNICAL INFORMATION

Insect.--Western spruce budworm, Choristoneura occidentalis Freeman

Hosts.--Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco
White fir, Abies concolor (Gord. & Glend.) Lindl.
Subalpine fir, Abies lasiocarpa (Hook.) Nutt.
Blue spruce, Picea pungens Engelm.
Engelmann spruce, Picea engelmannii Parry

Location.--The following seven entomological units were sampled in 1976 (Fig. 1):

Jemez East Unit (Fig. 2).--Espanola RD and Tesuque RD, Santa Fe NF; Bandelier National Monument - 10 plots.

Jemez West Unit (Fig. 3).--Cuba RD and Jemez RD, Santa Fe NF - 11 plots.

Gila Unit (Fig. 4).--Reserve RD, Gila NF - 10 plots.

Kaibab Unit (Fig. 5).--North Kaibab RD, Kaibab NF; North Rim, Grand Canyon National Park - 10 plots.

Manzano Unit (Fig. 6).--Mountainair RD, Cibola NF - 12 plots.

Sandia Unit (Fig. 7).--Sandia RD, Cibola NF - 10 plots.

Taos Unit (Fig. 8).--Taos RD, Carson NF; Taos Pueblo Indian Reservation - 10 plots.

Type of Damage.--Western spruce budworm larvae damage host trees by feeding on new foliage. Young larvae mine into the swelling buds and flowers in the spring. Mature larvae continue feeding on the expanding shoots and needles. As the larvae feed, they web shoots together. These webbed shoots become reddish brown by July and will eventually fall from the tree. Heavy defoliation for 4 to 5 years will cause trees to die, usually from the top downward.

Extent of Damage.--Western spruce budworm defoliation was detected during aerial surveys on all entomological units. Defoliation was visible over about 123,760 acres (50,086 hectares): 94,840 acres (38,382 hectares) - light; 26,080 acres (10,555 hectares) - moderate; 2,840 acres (1,149 hectares) - heavy.

METHODS

Region 3 was divided into entomological units, based on geographical locations where budworm infestations were found during the 1976 aerial detection survey. Within each unit, at least 10 plots were sampled during August 1976. Each plot consisted of 3 trees within a 1-acre (.01 hectare) area. Sampled trees met the following criteria: Douglas-fir; dominant or codominant; 30 to 50 feet (9.1 to 15.2 meters) in height; relatively open-grown with a full crown; some feeding evident, but not severely defoliated or with top-kill. Two 27.5-inch (70 cm) midcrown branches were cut from opposite sides of each sample tree with a pole pruner. The cut branches were measured to calculate foliated branch surface area. Each branch was then individually bagged in $\frac{1}{4}$-bushel (.03 cubic feet) paper sacks, sealed, labeled, and transported to the laboratory for examination. All sacks were stored in a walk-in cooler at about 40° F (4.4° C) prior to examination.

At least 60 Douglas-fir branches were collected for examination in each unit. The foliage from all branches was examined under ultraviolet light (Acciavatti and Jennings 1976) for egg masses. New egg masses (deposited in 1976) were separated from old ones (deposited before 1976) by a professional entomologist. The number of old egg masses in a given year reliably estimates the number of new egg masses the previous year (Buffam and Carolin 1966).

Mean densities of 1975 and 1976 egg masses per 1,000 square inches (.4 square meters) of foliage were calculated for each unit to determine infestation trend and predict defoliation expected in 1977. Infestation trend was based on testing the mean density difference between 1975 and 1976 egg masses with a "t" value ($P < .05$). Both increasing and decreasing infestation trends would have significant density differences from year to year, but an increasing trend would have a ratio of new (1976) to old (1975) egg masses greater than 1, while a decreasing trend would have a ratio less than 1. A nonsignificant density difference would indicate a static infestation trend. Defoliation predictions were obtained from the density of 1976 egg masses using Table 1.

RESULTS AND DISCUSSION

Western spruce budworm survey data from each entomological unit are presented in Table 2. Budworm infestations have expanded markedly in Region 3 since last year. Defoliation was visible on 123,760 acres in 1976 compared to 9,900 acres in 1975. Egg mass survey data indicate increasing infestation trends in the Jemez East, Jemez West, Manzano, and Taos entomological units. Defoliation is expected to be at least moderate in these units in 1977. The Gila, Kaibab, and Sandia entomological units have static infestation trends, and defoliation should remain at least light there next year.

Budworm populations have remained at high levels in the Southwestern Region for the second consecutive year. Even at these levels, however, tree damage as top-kill and mortality has been minimal. Growth loss probably has occurred in some isolated stands. Moderate to severe defoliation for 3 to 5 years will cause permanent tree damage. The present infestations are not expected to cause this type of tree damage during the next year.

RECOMMENDATION

Since the infestations have caused only minimal tree damage thus far, no control is recommended for 1977.

LITERATURE CITED

Acciavatti, R. E., and D. T. Jennings. 1975. Locating western spruce budworm egg masses with ultraviolet light. USDA Forest Serv. Res. Note RM-313. 3 pp.

Buffam, P. E., and V. M. Carolin, Jr. 1966. Determining trends in western spruce budworm egg populations. J. Econ. Entomol. 59(3): 1442-44.

McKnight, M. E., J. F. Chansler, D. B. Cahill, and H. W. Flake, Jr. 1970. Sequential plan for western budworm egg mass surveys in the central and southern Rocky Mountains. USDA Forest Serv. Res. Note RM-174. 8 pp.

Table 1.--Class limits for western spruce budworm egg mass densities and defoliation classes (From: McKnight et al. 1970).

Egg mass density[1]	Predicted defoliation class[2]
<1.0	Undetectable for all infestations
1.1 to 4.0	Undetectable for "static" infestations Light for "increasing" infestations
6.0 to 20.0	Light for "static" infestations Moderate for "increasing" infestations
>22.0	Moderate for "static" infestations Heavy for "increasing" infestations

1/ New egg masses per 1,000 square inches of foliage.
2/ Defoliation class limits (percent of new growth)
Undetectable = <5%
Light = 5 to 35%
Moderate = 35 to 65%
Heavy = >65%

Table 2.--Summary of western spruce budworm infestations, Region 3, 1976.

Entomological unit	Total acres of host type	Defoliated acres[1]	No. of branches sampled	Egg mass densities[2]			Infestation trend	Predicted 1977 defoliation class
				1975	1976	Ratio 1976:1975		
Jemez East	100,000	L = 2,520 M = 2,440 H = 0	60	4.6 ± 1.5[3]	10.9 ± 2.7	2.4:1	Increasing	Moderate
Jemez West	100,000	L = 8,400 M = 3,800 H = 240	66	4.4 ± 1.7	8.1 ± 2.4	1.8:1	Increasing	Moderate
Gila	40,000	L = 4,160 M = 2,320 H = 0	60	5.4 ± 1.4	6.4 ± 1.6	1.2:1	Static	Light
Kaibab	100,000	L = 62,840 M = 4,080 H = 400	60	12.3 ± 4.9	11.3 ± 3.8	0.9:1	Static	Light
Manzano	20,000	L = 1,320 M = 3,440 H = 320	72	7.4 ± 3.2	11.3 ± 3.2	1.5:1	Increasing	Moderate
Sandia	11,000	L = 6,200 M = 3,400 H = 1,320	60	10.4 ± 4.8	10.5 ± 3.3	1.0:1	Static	Light
Taos	75,000	L = 9,400 M = 6,600 H = 560	60	14.6 ± 3.3	24.7 ± 4.1	1.7:1	Increasing	Heavy
Totals	446,000	123,760	438					

1/ Aerial survey estimates: L = Light; M = Moderate; H = Heavy.
2/ Mean per 1,000 square inches of foliage.
3/ Confidence limits calculated at $P < .05$.

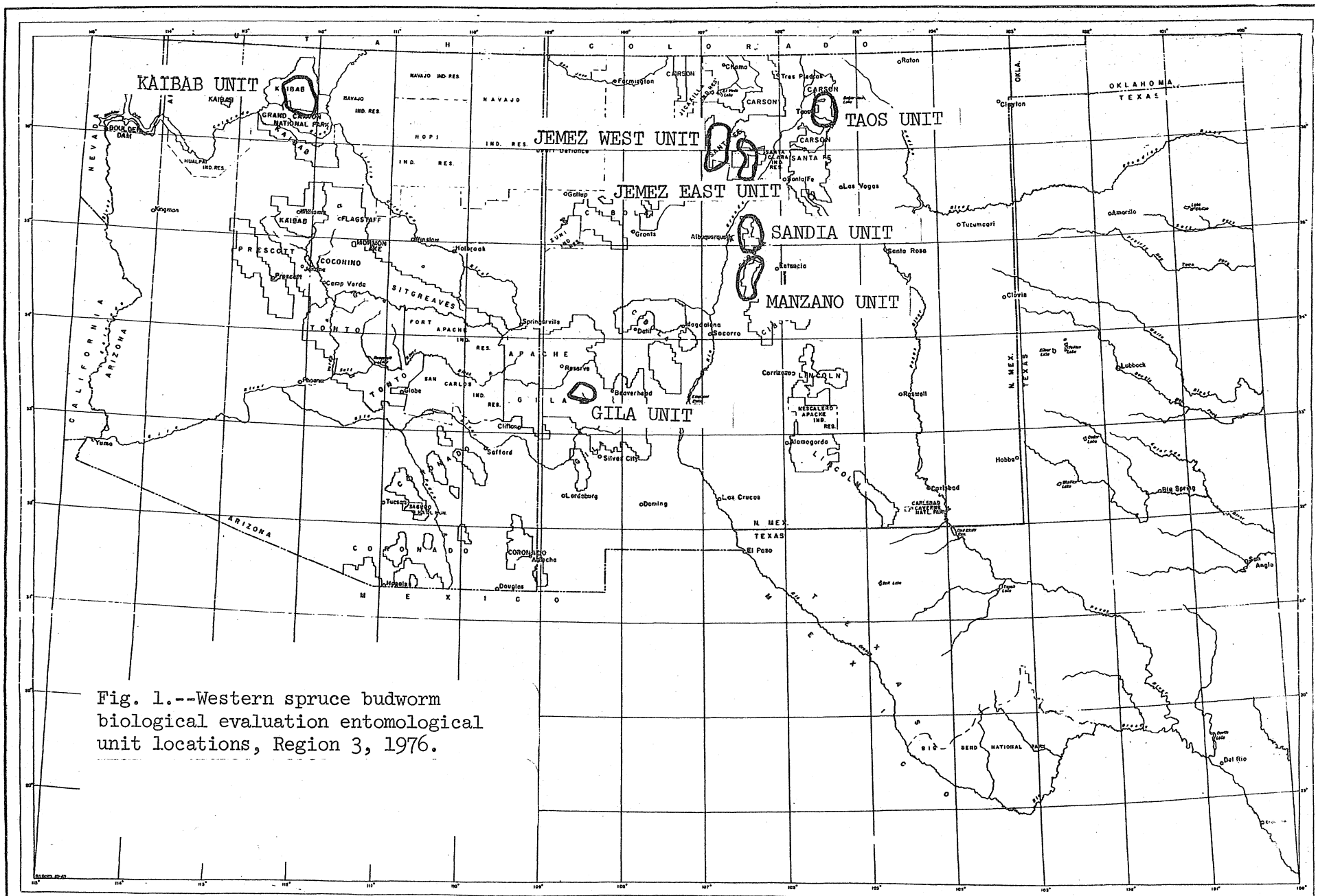

Fig. 1.--Western spruce budworm biological evaluation entomological unit locations, Region 3, 1976.

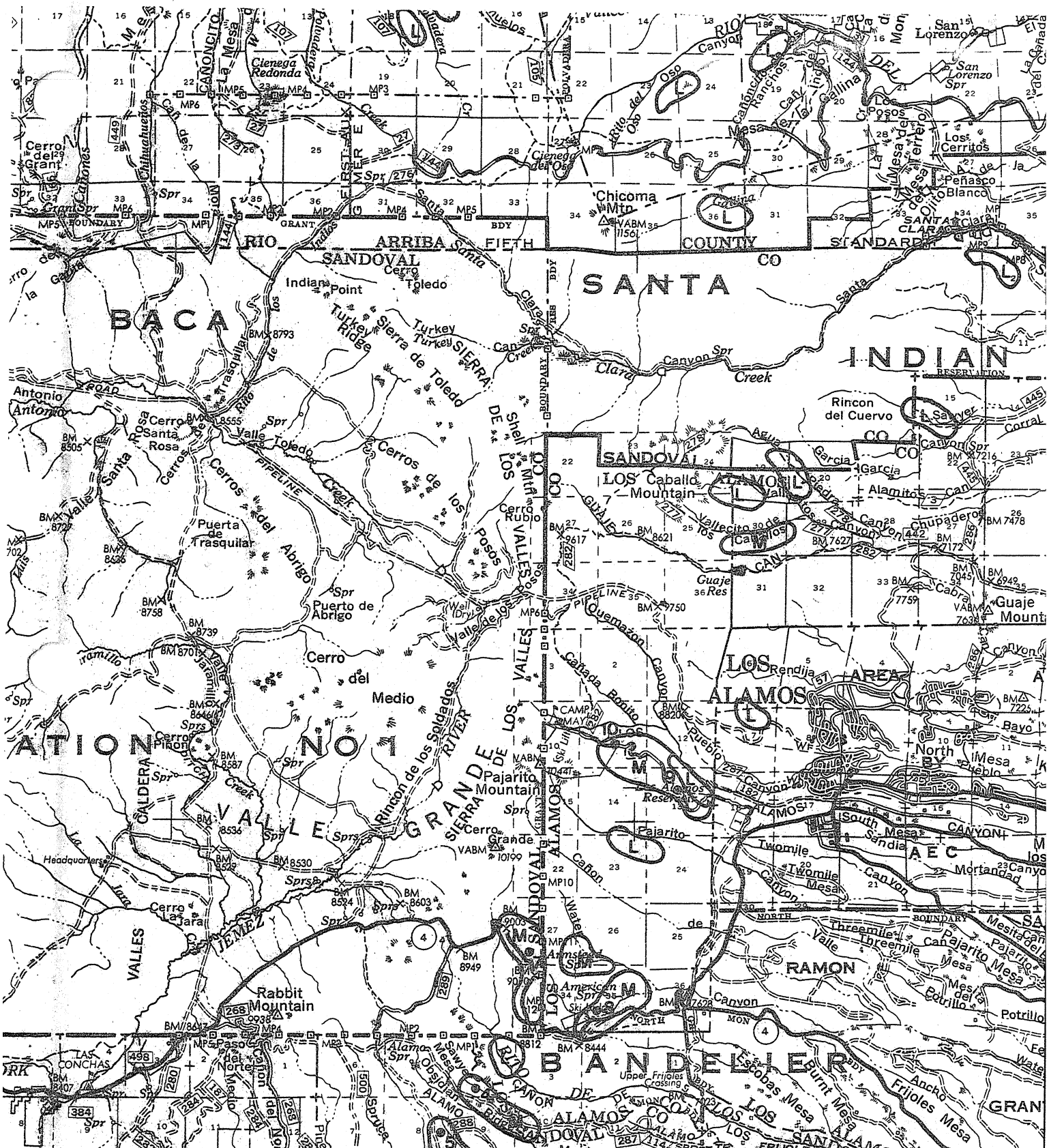

Fig. 2.--Western spruce budworm infestation, Jemez East Unit, Santa Fe NF, 1976.

Legend

Evaluation Plot Locations	2
Defoliation Intensity	
Light	L
Moderate	M
Heavy	H

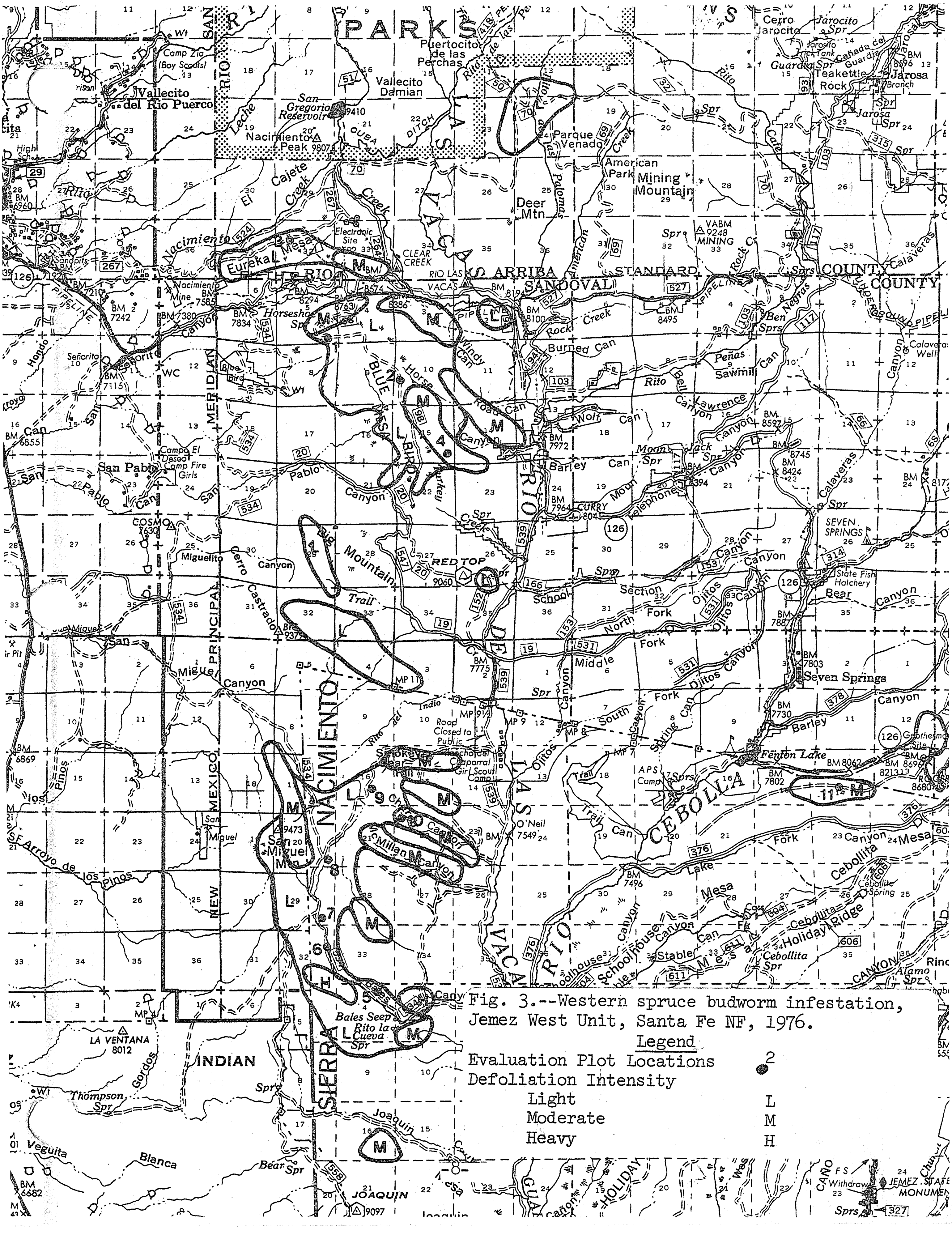

Fig. 3.--Western spruce budworm infestation, Jemez West Unit, Santa Fe NF, 1976.

Legend

Evaluation Plot Locations ● 2

Defoliation Intensity

Light	L
Moderate	M
Heavy	H

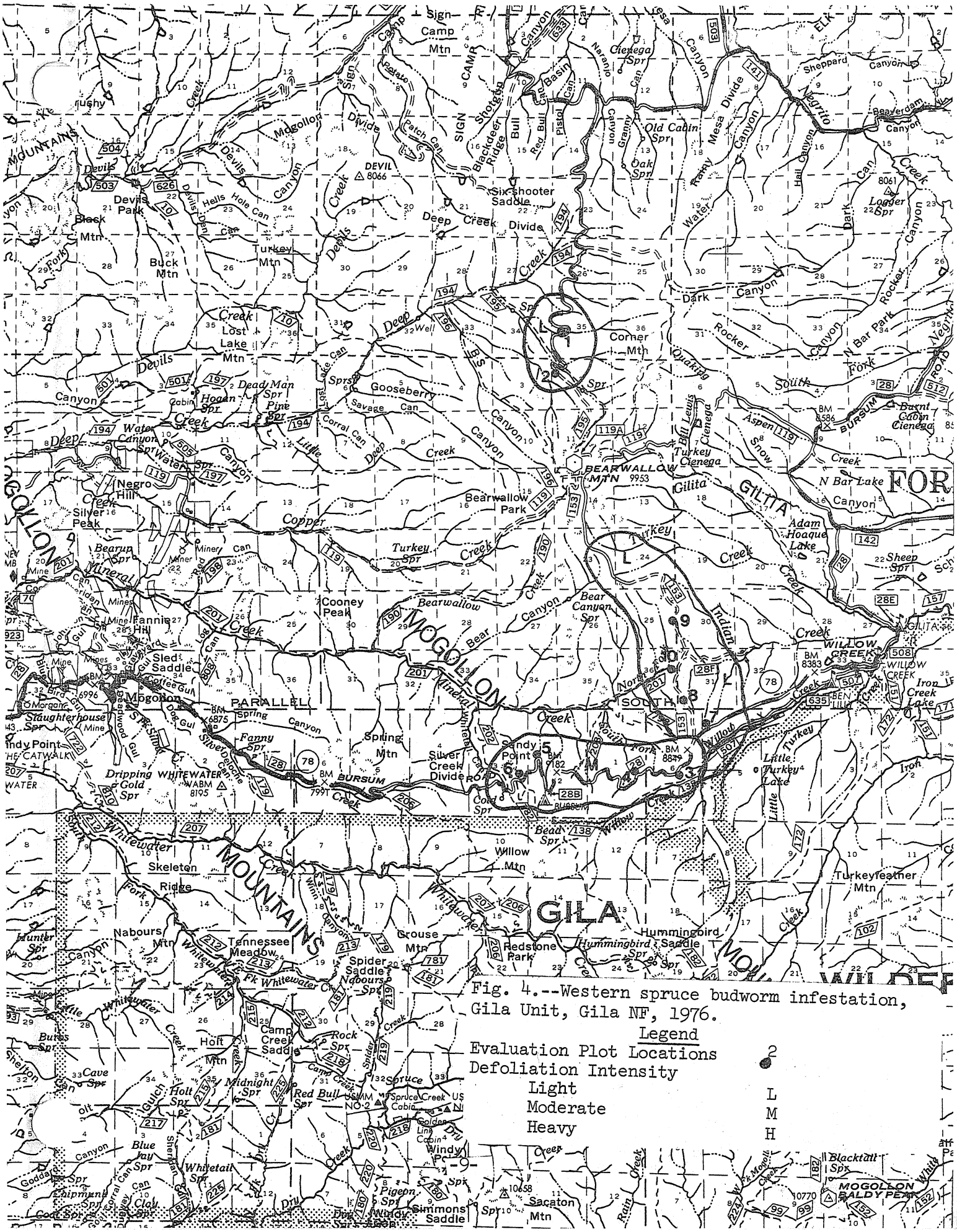

Fig. 4.--Western spruce budworm infestation, Gila Unit, Gila NF, 1976.

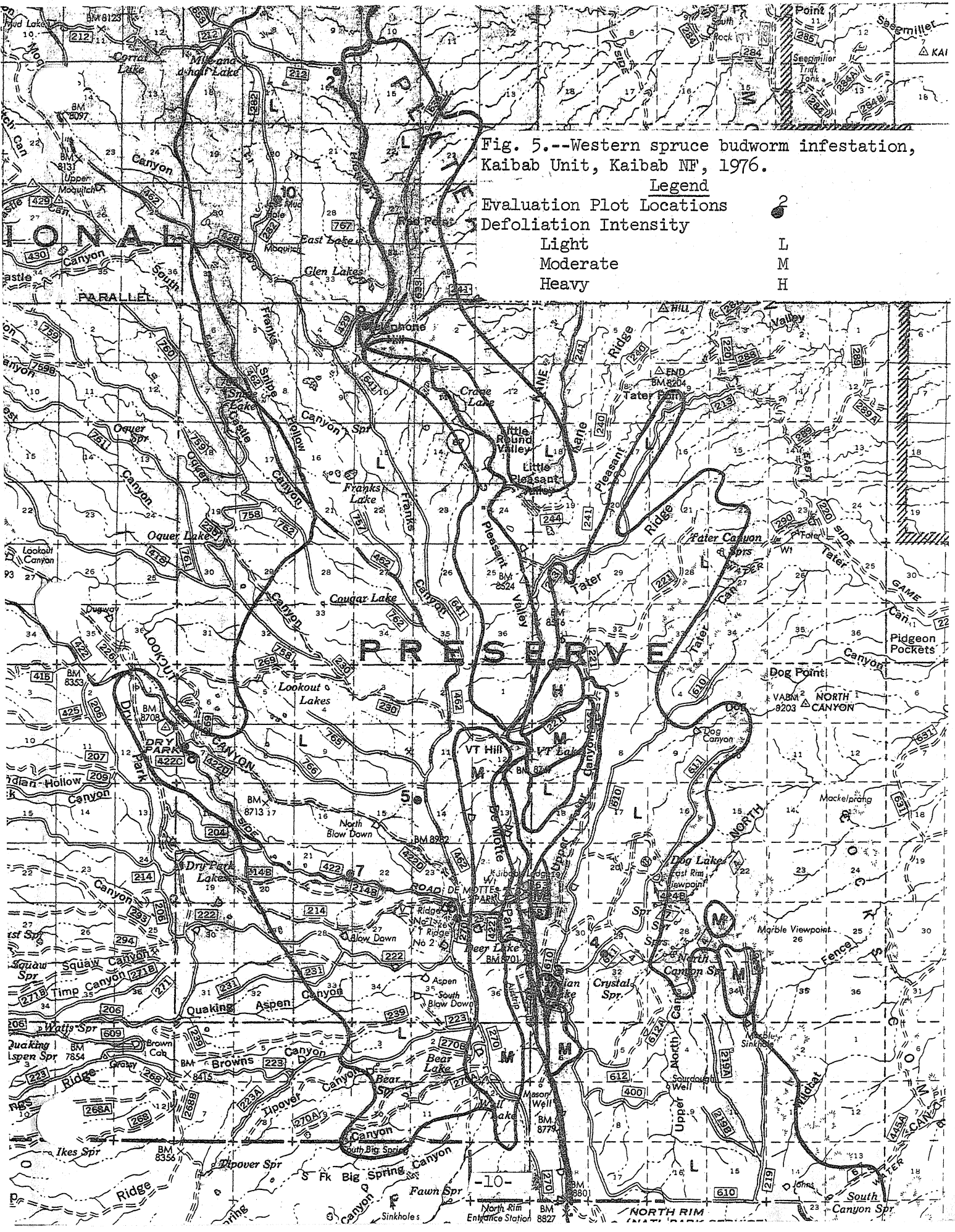

Fig. 5.--Western spruce budworm infestation, Kaibab Unit, Kaibab NF, 1976.

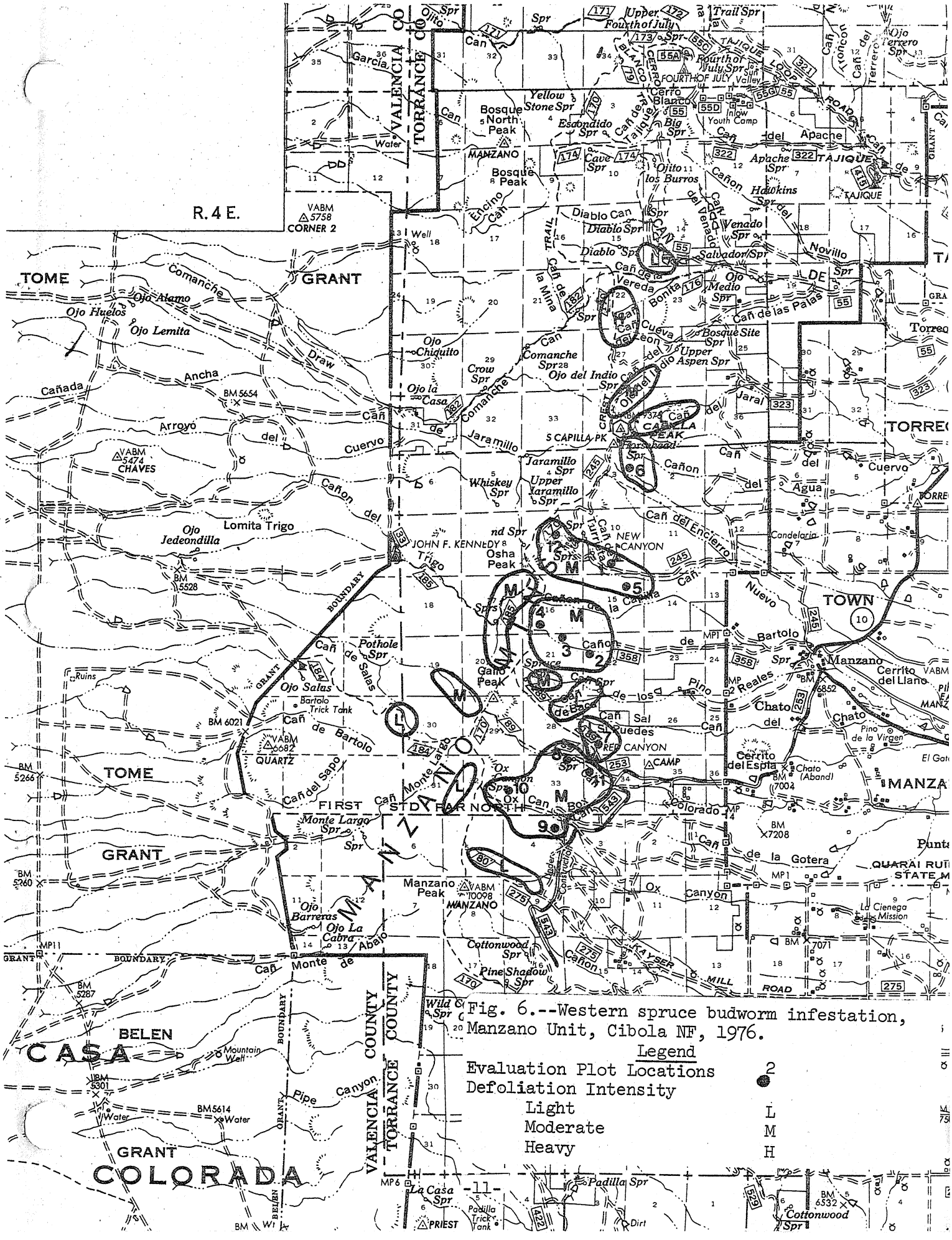

Fig. 6.--Western spruce budworm infestation, Manzano Unit, Cibola NF, 1976.

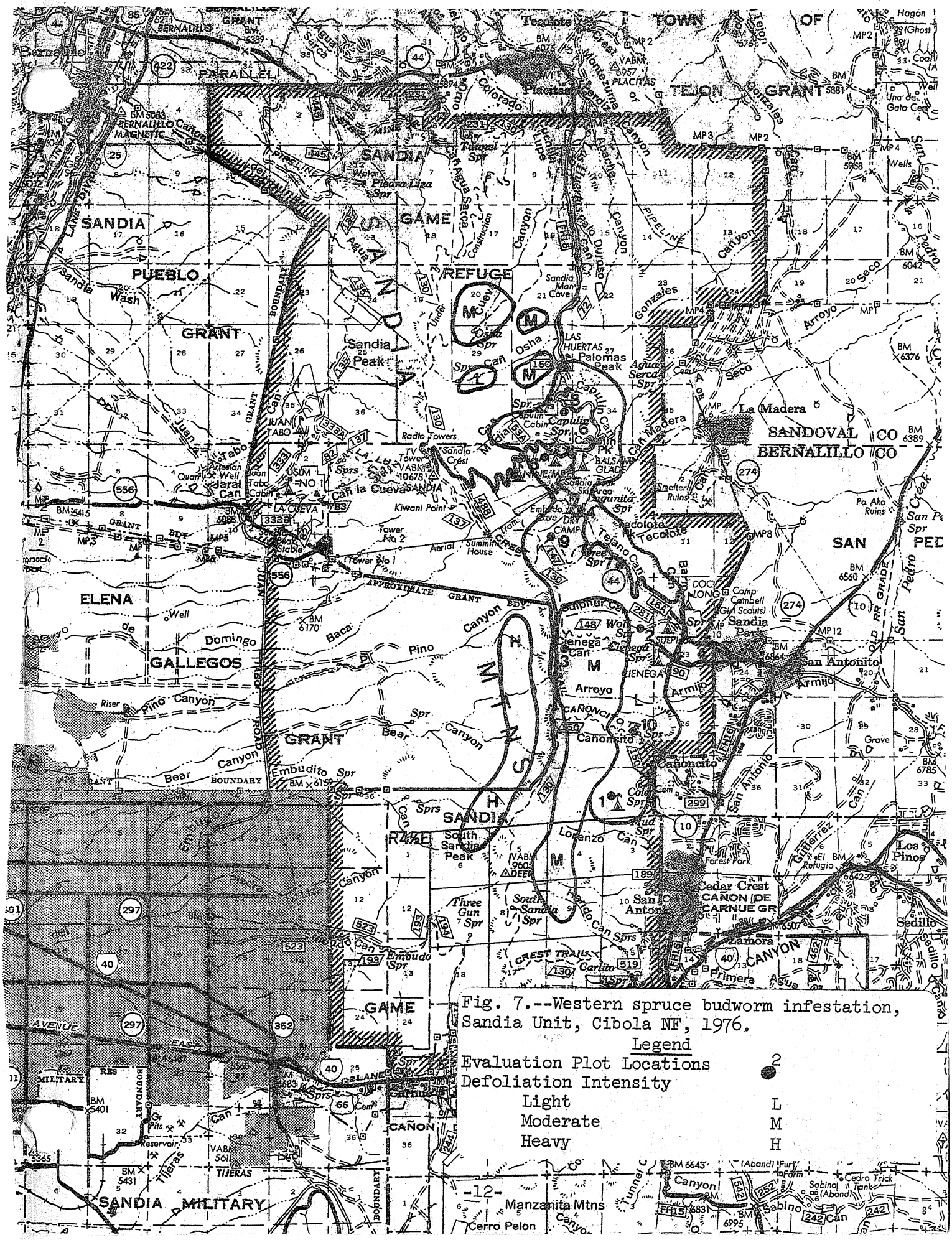

Fig. 7.--Western spruce budworm infestation, Sandia Unit, Cibola NF, 1976.

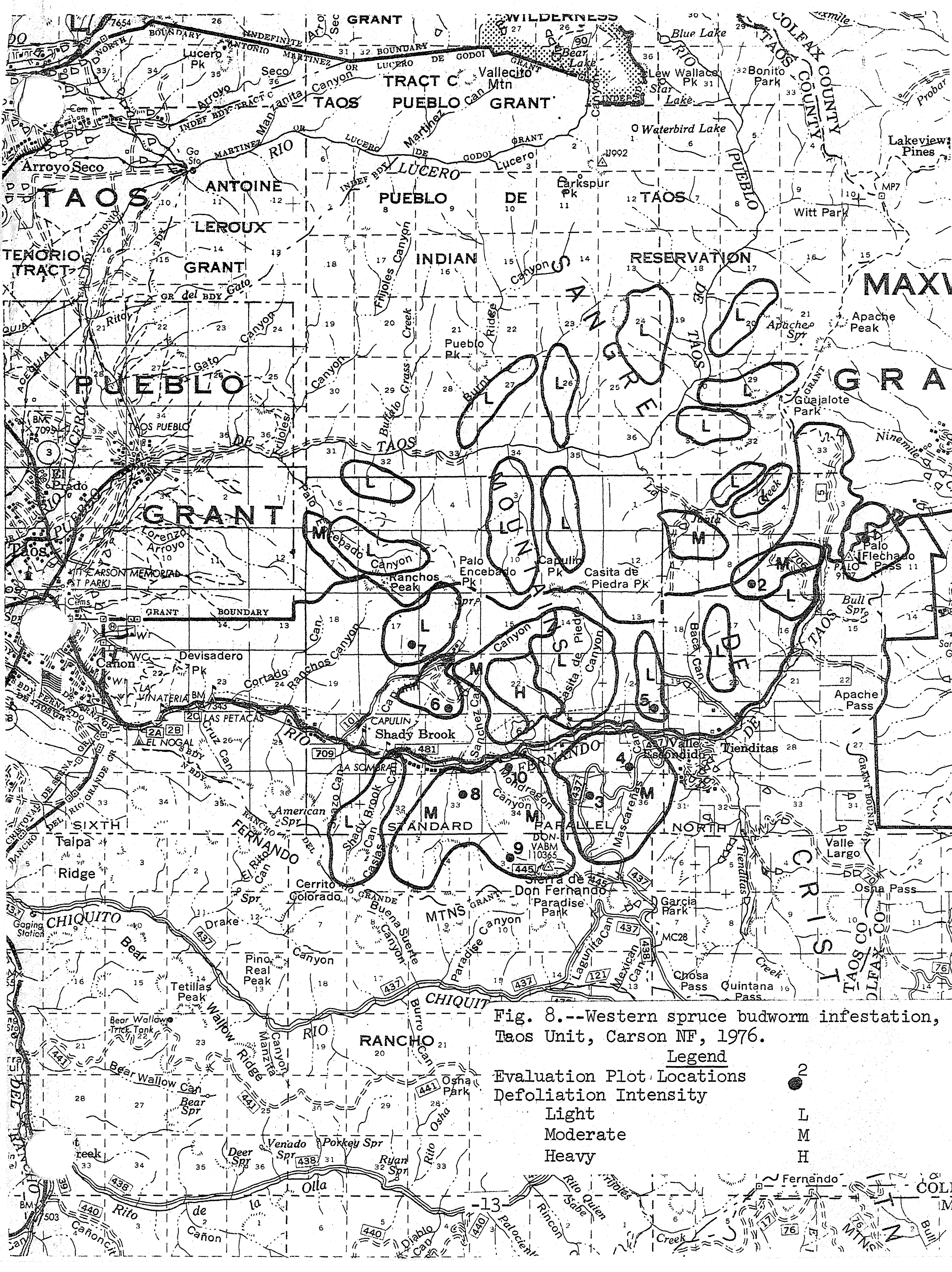

Fig. 8.--Western spruce budworm infestation, Taos Unit, Carson NF, 1976.

Legend

Evaluation Plot Locations	● 2
Defoliation Intensity	
Light	L
Moderate	M
Heavy	H